IMAGE PROCESSING APPARATUS, IMAGE PROCESSING METHOD AND STORAGE MEDIUM

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image processing apparatus for recognizing characters in a read image and generating a reproduced image based on the recognized characters. Further, the present invention relates to an image processing apparatus, e.g., a so-called digital copying machine or facsimile machine for transferring the thus-obtained reproduced image to an external device.

Related Background Art

In the character recognition technology, recent speeding up of a CPU and a semiconductor has enabled the processing in substantially real time at not much higher than the copying speed of a low-speed copier. Further, since most of originals to be copied are created by using a word processor and the like in late years, the accuracy in character recognition has been enhanced and come into practical use.

Additionally, the present applicant has already disclosed the technique for recognizing a character size or a character in an original in, e.g., Japanese Patent Application Laid-Open No. 61-107876 and the like.

Incidentally, since this type of copying machine sets down and processes an image as resolved dots obtained at a predetermined resolution, the reproduced image is liable to quality deterioration in principle

5 when copying a document which has been once copied, particularly when microcopying the document.

Furthermore, although this recent type of apparatus has a function to convert image information to a predetermined resolution to be transferred to an

10 external system in addition to a mere copying function, a problem may occur when uniformly processing the image at a resolution for transmission.

SUMMARY OF THE INVENTION

15 In view of the above-described prior art, it is therefore an object of the present invention to provide a copying apparatus for recognizing a character from an image and expanding the character to a dot font in accordance with a result of recognition to reproduce a

20 copy image. Particularly, an object of the present invention is to generate an image reproduced at a variable power or an image to be transferred.

The present invention provides an image processing apparatus comprising: a reading means for reading an

25 image in an original; a character recognizing means for recognizing a character in the image read by the reading means; a readout means for reading a character

font from the storing means in response to a result of recognition obtained by the character recognizing means; a detecting means for detecting information concerning the character in the image read by the reading means; and a generating means for generating a reproduced image based on the character font read by the readout means and the information concerning the character detected by the detecting means.

Further, the present invention provides an image processing apparatus comprising: a reading means for reading an image in an original; a recognizing means for recognizing a character in the image read by the reading means at a first resolution; and a generating means for substituting a font having a second resolution lower than the first resolution for the character recognized by the recognizing means to generate a reproduced image.

Furthermore, the present invention provides an image processing apparatus comprising: a reading means for reading an image in an original; a recognizing means for recognizing a character in the image read by the reading means; and a generating means for substituting an ornament-processed font for the character recognized by the recognizing means to generate a reproduced image.

Other objects, structures and advantages of the present invention will be apparent from the following

detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an image processing apparatus according to a preferred embodiment of the present invention;

Fig. 2 is a flow chart showing a flow of processing in the image processing apparatus;

Fig. 3 is a view showing reproduced character size and character gap;

Fig. 4 is a block diagram showing a hardware structure in a second embodiment;

Fig. 5 is a cross-sectional view of a copying apparatus in the second embodiment;

Fig. 6 is an exterior view of an operation unit in the second embodiment;

Fig. 7 is a projected view of characters in the second embodiment;

Fig. 8 is a tree diagram for explaining the character recognition processing;

Fig. 9 is a flow chart in the second embodiment; and

Fig. 10 is a view showing an operation screen of an image creation function.

DESCRIPTION OF THE PREFERRED EMBODIMENTS
(First Embodiment)

Fig. 1 is a block diagram showing an image processing apparatus which is a preferred embodiment according to the present invention. A CPU 3 reads an image in an original by controlling a scanner 4 through a bus 9, and image data read by the scanner 4 is accumulated and stored in an image buffer 8 via an image data bus 10. A recognition unit 7 detects a size and a position of a character in the original from the image data stored in the image buffer 8 and recognizes the character in the image data by making reference to a dictionary 6 to temporarily hold a result of character recognition, size information and position information in the image buffer 8.

After determining a size, a font type and others of the character used for a reproduced image in accordance with an instruction inputted from an MMI unit 1, character codes which have been already stored are sequentially expanded to dot font information and again held as recording dot information in the image buffer 8. This dot information is then supplied to a printer 5 to be recorded. In this manner, image recording and reproduction of a smaller character, which can not be obtained by the prior art digital copying machine, as a clear font character can be performed.

The detailed description will now be given to how to create reproduced image data according to the

present invention with reference to a flow of Fig. 2. The control based on this flow is effected by the CPU 3 based on a program stored in a ROM 11 or a RAM 12. It is to be noted that the program stored in the RAM 12

5   may be one read from a non-illustrated hard disk or from a CD-ROM or a floppy disk. In addition, functions of blocks other than the scanner 4 and the printer 5 in Fig. 1 may be executed by a computer. In this case, this program can be read from a CD-ROM or a floppy disk

10   or it can be downloaded from a network.

When reading a short side width of 200mm of an A4-size original at a resolution of 600DPI (dot-per-inch), it is assumed that a total number of pixels read in the buffer (step 100) is 4724 pixels and existence of 40

15   characters on this original is detected by a histogram or the like on an image. In this case, the width of one character is determined as 4724/40 = 118.1 pixels (step 101). This character width is defined as a width obtained by adding a space to an actual character size.

20   A character size in each character width is detected by a well-know technique such as a histogram or the like (step 102) and, if 12 points equal to 100 dots, 118.1 - 100 = 18.1 pixels correspond to a spacing (character gap) between characters in the original.

25   Based on the above-mentioned information, the character recognition is carried out with respect the entire area of the original and code data is stored in the image

buffer (step 103).

Assuming that the copy magnification is set to 70% by an operator (step 104), tne same 40 characters must be recorded in the width of 4724 × 0.7 = 3307 pixels. That is, the character width allocated to one character corresponds to 3306.8/40 = 82.67 pixels, and the character size is 12 × 0.7 = 8.4 points (70 dots) (steps 105 and 106).

In this case, since the character width is not an integer, it is preferable to set the character width to an integer that is suitable for recording. However, when the character widths are all set to 82 pixels or all set to 83 pixels, the character size can be associated with a set copy magnification whilst the character size (character gap) can be slightly different from one corresponding to the copy magnification, thereby disabling true reproduction at the set copy magnification. As a countermeasure, 82 pixels and 83 pixels are both used for the character width in one row properly and allocation is so determined as to provide 3307 pixels in the entire one row in this embodiment.

In other words, it is determined that 83 pixels correspond to 40 × 0.67 = 26.8 ≈ 27 characters and 82 pixels correspond to 40 - 27 = 13 characters. When allocating and arranging the number of characters in the original by using two types of character width,

i.e., N pixels and N+1 pixels at a predetermined ratio in accordance with a set copy magnification, the characters can be arranged within the full pixel number substantially at a predetermined magnification. It is

5   needless to say that the two kinds of character width are uniformly arranged in accordance with its ratio of a number of characters. In this example, they are uniformly arranged as 83, 83, 32, 83, 83, 82, ...

A character size to be expanded in the both

10   character widths will now be described. Generally, when expanding a character font from a dictionary to dot data having an arbitrary size, the size is set to an integer. In the above-described example, when making an attempt to reproduce an image in an accurate

15   size at a recording density of 600DPI, the character size corresponds to 600 × 8.4/72 = 70 pixels which is an integer, but if a character in the original is 14 points, the size corresponds to 0.7 × 600 × 14/72 = 81.67 pixels which is not an integer.

20   Therefore, in such a case, two types of character size, i.e., 81 pixels and 82 pixels are set to be uniformly arranged at a ratio of 1 to 2, and it is enough to expand respective characters in different sizes in accordance with this setting (step 107).

25   In case of a 70%-microcopied image, a character font of 8.4 points is expanded in the character widths of 82 pixels and 83 pixels respectively in a size of 70

pixels and arranged, thereby creating recording image data for one page. It is to be noted that the above description has given only as to the one-way processing but the same processing will be executed with respect to a direction orthogonal thereto. Fig. 3 shows a result of the above-described processing. An expanded character dot in a one-character region separated by the character width of 82 pixels or 83 pixels can be arranged at an arbitrary position, but it is determined that the upper left portion in the drawing is a reference position in Fig. 3.

<determining character size>

In order to prevent the speed for changing the character size in one pixel increments for each character to be expanded from lowering, a fraction of the character size calculated by the operation is omitted to obtain an integer. In the above-described example, the character size is set to 81 pixels. That is, since the character width is controlled at one close to the indicated magnification, reproduction as a document is possible if the character size to be expanded in the one character width is not more than the character width.

<determining character width>

In cases where a magnification is not set as a figure as in the above-described example and a fixed variable power, e.g., A4 to A5, is indicated, the

character width which is 82.67 in a narrow sense in the above-described example is adjusted to an integer 82. That is, although a percentage of reduction is 82 × 40/4724 = 69.43% accurately, it is enough only if information in the A4-size original can be recorded on the A5-size paper in full. Further, a number of recordable pixels on the paper having the same size may vary depending on each recording apparatus which is actually used, and hence it is advantageous to unify numbers of pixels to a maximum character width by which no information can be missed in the entire recordable area.

<determining font>

Although the above-described example apparently premises that a font which is much closer to a character in the original is selected as a counter part used for a reproduced image for copying the original in the above-described example, an arbitrary font can be selected according to a direction inputted from the MMI unit 1 by an operator in order to reproduce an image.

<resolution for reading image>

In the above-described example, the original is read at the equivalent magnifying power irrespective of types of the subsequent variable power processing and the like and stored in the image buffer 8, and the original information is recognized or detected.

However, when the size of the original is much smaller

than A4 and smallness of characters in the original as in a business card or a postcard can be predicted for example, the accuracy of recognition can be improved by enlarging and reading the original and performing the

5 character recognition using the image signal.

As described above, according to the first embodiment, characters in an image on a read original are recognized; information relating to the characters in the read image is detected; a character font is read

10 in accordance with a result of character recognition; and a reproduced image is generated based on these character font and information concerning the characters, thereby restraining the quality of the small characters from deteriorating during duplication.

15 Further, when repeating copy of the image reproduced in the above-described structure as an original, the quality of the image can be prevented from being degraded.

(Second Embodiment)

20 Fig. 4 shows a block diagram according to a second embodiment, and each constituent part and the operation thereof will be described hereinbelow.

An original 1001 is image-formed to a CCD 402 by using a lens 401 of an image reading unit 1002 and A/D-

25 converted by an A/D converter 403. A signal obtained after A/D conversion is inputted to an image processing unit 1003. The inputted signal is further subjected to

shading correction 404 in the image processing unit
1003 and supplied to a mode change circuit 405.

Here, a destination of the signal is changed based
on a recognition copy mode or a normal copy mode in

5   accordance with the setting by an operator from an
operation unit 416. In case of the normal copy mode, a
light/density conversion circuit 406 is used to convert
brightness data into recording density data to be
outputted to an image compilation unit 407. The image

10   compilation unit 407 performs the compilation
processing based on data processed according to the
content of setting of the image processing stored in a
RAM 415 within a CPU circuit 413. When carrying out
recording reproduction, the compiled image data is

15   outputted to an image recording unit 1004. Meanwhile,
if the image information is transferred to any other
system via a so-called FAX, a network such as a LAN or
various personal computer IF's, predetermined processes
such as compression, encoding, demodulation and others

20   are effected in an image transfer unit 419 and the
image information is thereafter outputted outside.

The image recording unit 1004 is constituted by a
control circuit such as a motor for feeding transfer
paper or the like, a laser control circuit for writing

25   a video signal inputted from the image processing unit
1003 onto a photosensitive drum and a development
control circuit for performing development, and records

an image on a recording medium such as recording paper.

On the other hand, when the recognition copy mode
is set, the destination of the signal from the mode
change circuit 405 is changed to an image recognition
5   unit 4000. The image recognition unit 4000 recognizes
characters in the original by using an image buffer
memory 418, and a result of recognition is transferred
to an image data conversion unit 410 where a character
code which is a recognition output is converted into an
10   output font image signal.

Further, an operation unit 416 includes a group of
various keys for indicating the content of image
compilation, a number of copies, an image copy
operation such as a variable power and the like with
15   respect to the image processing unit 103, a group of
various LED's, a display unit for displaying the
content of operation and others.

Fig. 5 is a cross-sectional view showing the
structure of the image copying apparatus in this
20   embodiment.

In Fig. 5, numeral 501 designates an original
feeding device as an original feeding means for feeding
the original mounted thereon to a predetermined
position on a glass platen 502 every one sheet or two
25   sheets. Numeral 503 denotes a scanner constituted by a
lamp, a scanning mirror 505 and others and, when the
scanner 503 is mounted on the glass platen 502 by the

original feeding device 501 and an instruction of,
e.g., copy or character recognition is given from the
operation unit 416, the scanner scans in a
predeter.ined direction (horizontal direction in the
5   drawing) to pass a reflected light ray from the
original through a lens 508 via scanning mirrors 505 to
507 to form an image in an image sensor unit 509.

Numeral 400 represents a control unit having
various circuits shown in Fig. 4 mounted thereon.
10   Numeral 510 denotes an exposure unit for receiving the
image signal from an image signal control unit (not
illustrated) which generates the image signal based on
the image data from the image compilation unit 407
within the control unit 400 to irradiate a light beam
15   onto a photo conductor 511. Numerals 512 and 513
designate developers for visualizing an electrostatic
latent image formed on the photo conductor 511 by using
a developer (toner) having a predetermined color.
Numerals 514 and 515 denote transfer paper mounting
20   units for mounting and accommodating a recording medium
having a fixed size therein, and the paper is fed to a
position at which a resist roller is provided by
driving a feeding roller and the paper is again fed in
timing with alignment of an edge of an image formed on
25   the photo conductor 511.

Numeral 516 represents a transfer separation
charger which transfers a toner image developed on the

photo conductor 511 to the transfer paper and is then separated from the photo conductor 511 to be fixed by a fixation unit 517 via a carrier belt. Numeral 518 designates a discharge roller which mounts and

5   discharges the transfer paper on which the image has been already formed to a tray 20. Numeral 519 denotes a direction flapper which changes a direction to feed the transfer paper on which the image has been already formed to a discharge opening and an internal feeding

10   direction and is prepared for the multiple/double-sided image forming process.

Fig. 6 is an exterior view showing the operation unit 416 used in this embodiment.

Numeral 601 designates a power supply switch for

15   controlling power supplied to the body of the apparatus. Numeral 602 expresses a reset key which functions as a key for returning to the standard mode during standby. Numeral 603 corresponds to a copy start key. Numeral 604 denotes a clear key used for

20   clearing a value such as a number of copies.

Numeral 605 represents an ID key which enables the copy operation with respect to a specific user and disables the copy operation with respect to any other user unless an ID is inputted by the ID key. Numeral

25   606 designates a stop key used for interrupting or stopping copy. Numeral 607 denotes a guide key for giving information about each function. Numeral 608

represents an upper cursor key for moving a pointer upwards in each function setting screen. Numeral 609 designates a lower cursor key for moving the pointer downwards in each function setting screen. Numeral 610 expresses a right cursor key for moving the pointer to the right-hand side in each function setting screen. Numeral 611 represents a left cursor key for moving the pointer to the left-hand side in each function setting screen. Numeral 612 denotes an OK key which is pressed in each function setting screen when everything is just fine as it is.

Numeral 613 designates a key which is pressed when executing output in the lower right portion in the screen 652 in each function setting screen. Numeral 614 represents a fixed reduction key used for scaling down a fixed size to another fixed size. Numeral 615 denotes a key which is used for selecting an equal magnification copy. Numeral 616 signifies a fixed enlargement key used for scaling up a fixed size to another fixed size. Numeral 617 denotes a cassette selection key for selecting a cassette stage used for copy. Numeral 618 represents a copy density adjustment key for reducing the density. Numeral 619 expresses an AE key for automatically adjusting the copy density relative to the density of the original. Numeral 620 denotes a copy density adjustment key for increasing the density. Numeral 621 represents a key for

designating the operation of a sorter. Numeral 612
designates a preheat key used for turning on/off the
preheat mode. Numeral 623 signifies an interruption
key which is pressed when interrupting the copy

5   operation to perform another copy operation. Numeral
624 denotes a ten key used for inputting a value.

Numeral 625 expresses a marker processing key for
setting trimming, masking and partial processing
(italic, outline processing, meshing processing,

10   shadowing processing, negative/positive reversal
processing). Numeral 626 denotes a patterning
processing key used for patterning colors for
expression or giving difference in density of colors
for expression. Numeral 627 designates a color

15   elimination key used for eliminating a specific color.
Numeral 628 represents an image quality key used for
setting the copy mode concerning the image quality,
e.g., the recognition copy according to the present
invention. Numeral 629 represents a meshing processing

20   key used for executing the meshing processing. Numeral
630 designates an image create key used for carrying
out the outline processing, the shadowing processing,
the negative/positive reversal processing, italic, the
mirror processing and the repeat processing. Numeral

25   631 denotes a trimming key used for specifying an area
to be trimmed. Numeral 632 represents a masking key
used for specifying an area to be masked. Numeral 633

designates a partial processing key for specifying an area to thereafter further specify the partial processing (italic, outlining, meshing, shadowing and negative/positive reversal). Numeral 634 denotes a

5   frame erasing key used for erasing a frame in accordance with each mode. The modes include: a sheet frame erasing mode (creating a frame relative to a sheet size); an original frame erasing mode (creating a frame in accordance with the original size. The

10   original size is specified); and a book frame erasing mode (creating a frame and a blank in the central part in accordance with a two-page spread size of a book. The book two-page spread size is specified). Numeral 635 represents a stitch width key used for creating a

15   stitch width on one end of the paper.

Numeral 636 denotes a movement key for moving an image in a desired area, which is used for moving the image. The types of movement include: a parallel movement (vertical and horizontal movements); a center

20   movement; a corner movement; and a specified movement (a point specified movement). Numeral 637 represents a zoom key by which the copy magnification can be set from 25% to 400% in 1% increments. Further, the main scanning and the sub scanning can be independently set.

25   It is to be noted that the variable power for the image in the sub scanning direction on the original can be set by controlling the moving speed of the scanner 503

whilst that in the main scanning direction on the original can be set by performing the pixel skipping or interpolation of the image data read by the scanner 503.

Numeral 638 designates an auto variable power key for automatically scaling up and down in accordance with a size of copy paper. Further, the main scanning and the sub scanning can be independently subjected to auto magnification change. Numeral 639 denotes an enlarged continuous copy key used for scaling up and copying one sheet of the original to multiple sheets. Numeral 640 represents a reduced layout key used for scaling down and copying multiple sheets of the original on one sheet. Numeral 643 denotes a continuous copy key used for horizontally dividing a copy area on the glass platen into two and performing the continuous copy for automatically copying two sheets (page continuous copy, double-sided continuous copy). Numeral 644 designates a double-side key used for outputting the double-sided copy (single-sided - double-sided, page continuous copy - double-sided, double-sided - double sided). Numeral 645 represents a multiplex key used for multiplexing (multiplexing, multiplexing of page continuous copy). Numeral 646 indicates a memory key used for effecting a mode using a memory (memory synthesizing, area synthesizing, watermark synthesizing). Numeral 647 designates a

projector key which is used when a projector is needed. Numeral 648 denotes a printer key used for setting use of a printer. Numeral 650 represents an original consolidation key used to copy with a feeder when the

5   original having the various sizes is mounted. Numeral 651 denotes a mode memory key used for calling a registered copy mode in order to register the copy mode set for copy. Numeral 652 designates a liquid crystal display unit having a touch panel, which displays the

10   state of the apparatus, a number of copies, the magnification of copy and the size of copy paper or displays the mode setting of the normal copy mode and the content of the set copy mode.

In regard of the FAX function, a destination or

15   various kinds of transmission mode can be set by pressing the key 655 to perform display of the liquid crystal display unit having a touch panel and inputting from the touch panel key. For example, in G3, a two-valued image signal is compressed and encoded to be

20   transmitted at the resolution of 8 × 3.85 lines/mm in the standard mode; 8 × 7.7 lines/mm in the fine mode; and 16 × 15.4 lines/mm in the super fine mode.

The character recognition unit characterized in the present invention will now be described in detail

25   hereunder. The image signal read at 600DPI that is a maximum resolution in the present system and stored in the image buffer memory 418 for the recognition

processing is supplied to a character cutout unit 408
where the binary-coded image is obtained and divided
into average character meshes each of which includes
one character based on the projection in orthogonal two

5   directions. Fig. 7 is a view showing the state of
projection in one direction. An average line gap G and
an average character height H are obtained from this
histogram, and the average character mesh including one
character may be set based on these values. The size

10   of a character to be recognized according to the
present invention can be specified based on the size of
each mesh to which the image is divided. Meanwhile,
the character in each mesh is normalized and its
quantity of characteristic is obtained as an unknown

15   character vector by a vector calculation unit 409.
When, for example, the quantity of characteristic of an
unknown character is inputted to the recognition
control unit 411, this control unit calculates a
minimum distance from a standard pattern of each group

20   to the unknown character in each step of multiple steps
in which consecutive similar standard patterns are
grouped to constitute the next step along a tree
structure of a dictionary belonging to the control
unit. This control unit performs the descending

25   retrieval along the tree structure while forming a path
linking groups giving the minimum distance and outputs
a result of character recognition in the minimum

distance obtained in the final step as a recognized character.

Fig. 8 shows the above-described recognition method using a dictionary having the tree structure in case of recognizing an unknown character " 王 ".

Here, assuming that a standard pattern vector (quantity of characteristic) in an i-th group in one step in the dictionary having the tree structure is represented as $*v^i$ and an input vector of the unknown character as $*u$, the distance between the vector $*vi$ and the vector $*u$ can be expressed as follows with r as a dimensional number for the vector:

$$di \sum_{K=0}^{r-1} | *v^i K - *uK |$$

where $*v^i = (v^i_0, v^i_1, \ldots, v^i_{r-1})$

$*uk \ (u_0, u_1, \ldots, u_{r-1})$

This is the above-mentioned distance to be obtained and, in each step, a group by which this distance is minimum is selected and the path to the character " 王 " in the final step shown in Fig. 8 is formed.

When the image included in each mesh is recognized by using a dictionary in this manner, if the image in the mesh is not a character, for example, if it is a part of a line segment constituting a chart or symbol, a specific character or a symbol stored in the dictionary is regarded as having the minimum distance irrespective of an absolute value of this distance.

Therefore, when a part of a rule mark is orthogonal to a numeric character " — ", they are converted into another numeric character " ┼ ". Thus, assuming that the distance to the character obtained in the final step is V, the following judgment is made:

$V < K$ ... the content of the mesh is a character

Otherwise ... the content of the mesh is other than characters

(K is a constant)

That is, the input is determined as a character only when the distance V is not above a predetermined value K, and it is determined as the image information in any other case. Therefore, if $V < K$ in the example shown in Fig. 8, an image data conversion unit 410 converts the input into dot data by using a font ROM thereof based on a two-byte code indicative of the character " ┼ ". Accordingly, if $V \geq K$ in the recognition control unit 411, the image data stored in the image buffer memory is selected and transmitted to the image compilation unit, whilst if $V < K$, the corresponding font data is selected and transmitted to the same, respectively.

By carrying out the above-described processing with respect to all the meshes, the character portion can be recorded and displayed by using a recognized character font, and any area other than characters can be also recorded and displayed as a reproduced image in

which the font data and the image information similar
to that in the prior art copying machine are mixed.

When reproducing an image by mixing the image
information and the font data in this manner, the
5   quality of a reproduced image can be improved by using
the font data which matches to a character style of
characters in the original. Recognition of a character
style will now be described as a characteristic of the
present invention with reference to a flow chart in
10   Fig. 9.

Referring to Fig. 9, a quantity of characteristic
is calculated from an image signal in each mesh which
is obtained by performing mesh division S10 as
mentioned above and, if the minimum distance V is not
15   more than the predetermined value K as a result of
character recognition S11 using a dictionary, two-byte
information is stored S13 at its mesh address as a
character code.

In this case, since the probability that the
20   recognized image corresponds to a character is
apparently high, a quantity of characteristic of a
character style Sj is calculated. This quantity of
characteristic is a physical quantity which is typical
in, for example, a thickness distribution of a line
25   segment and mainly used for recognition of Ming,
Gothic, italic or the like. This quantity of
characteristic for each mesh is sequentially added S15

and this addition is repeated relative to the images in all the meshes. Upon completion S16, the average quantity of characteristic of the character style integrated in S15 is used to carry out the character

5 recognition S17 by utilizing a dictionary prepared in advance.

It is to be noted that font expansion S18 is performed using a determined character style. Incidentally, since the process is jumped from S12 to

10 S16 when the distance V is not less than K, the quantity of characteristic of a figure and the like is not added in S15, and hence the accurate recognition is possible in the character style recognition S17. It is to be noted that the character size obtained during the

15 mesh division and the recognized character style can be used for substitution of the font data which is faithful to the original but the font expansion using a predetermined character style is also possible irrespective of a result of character style

20 recognition. Description will be given as to the italic conversion as an example.

When the image create function is selected by the above-mentioned operation key 630, the screen of the liquid crystal display 652 is changed to a screen 1000A

25 in which an italic character key 1004 is selected. When the italic character is selected, the screen is further changed to another screen 1000B in which an

italic angle is set. Each recognized character is expanded in the italic font having the italic angle set by adjusting increase/decrease keys 1006 and 1007, thereby completing substitution.

5   Arranging the expanded italic font data in such a manner that the center of the data is in suit with that of each mesh enables conversion into the italic without deviating from the first character position in the original.

10   In the prior art, since this italic function is realized by reading the character as an image and sequentially shifting the image signal in an alignment direction of the CCD sensor for a very small number of pixels every line, an image portion other than

15   characters is also rhombically deformed and top positions of character lines can not be aligned in the front and rear edges of the image, thus restricting the usage. According to the present invention, however, the italic processing is possible only to a complete

20   character portion.

      It is to be noted that the trimming key 631 can be used to perform the italic conversion with respect to only characters in a predetermined area.

      Description will now be given as to the font

25   expansion using a set specific resolution when transferring a reproduced image signal to another system such as a FAX. In case of the present

invention, even if a resolution required for a final image to recognize character in the original is low, the recognition processing must be effected at a high resolution by which stable recognition is possible.

5   Therefore, conversion into a directed resolution is carried out during the font expansion of a recognized character.

If the recognized characters in the original have a size of 14 points, each recognized character is

10   expanded to recording dots having approximately 117 × 117 pixels when recording and reproducing at a recording density of 600DPI as usual. Now, assuming that the image transmission in the FAX standard mode is selected, since the recording density is 8 × 3.85

15   lines/mm, each recognized character is expanded to dots having 40 × 19 pixels in order to record and display each character in the size equal to 14 points at a destination. Similarly, when transmitting and inputting each recognized character to another personal

20   computer or the like at the resolution of 300 × 300 DPI for example, the character is expanded into dots having 58 × 58 pixels.

It is to be noted that the usual resolution conversion from 600 DPI to a specified resolution is

25   carried out with respect to the so-called image data which can not be character-recognized in order that the image data can be recorded and displayed as an image

having the same size at a destination.

(Third Embodiment)

If a resolution during transmission is low and a
size of recognized characters is small, the font
expansion by which a number of dots becomes smaller
than that of an usual font must be carried out. In
this case, the size is unchanged but the characters
become unclear due to the pixel skipping processing.
Therefore, the dot expansion is executed by using a
rough character font in accordance with a recognized
character size and a resolution. For example, it is
determined as follows:

The rough character font expansion is performed
in case of not more than 100DPI and not more than 12
points;

The rough character font expansion is performed in
case of 200-100 DPI and not more than 10 points;

The rough character font expansion is performed in
case of 400-200 DPI and not more than 8 points;

The rough character font expansion is performed in
case of 600-400 DPI and not more than 5 points; and

The usual font expansion is performed in any other
case.

It is to be noted that the above-described setting
can be changed by a user.

(Fourth Embodiment)

The above has explained the image create function

relative to italic characters in the font expansion

and, similarly, various kinds of character ornament

processing such as the meshing processing, the

negative/positive reversal processing, the outline

5   processing, the shadowing processing and others are

possible with respect to recognized characters. At any

rate, they are carried out for each font in the font

expansion relative to each character.

As mentioned above, according to the second to

10   fourth embodiments, the reproduced image signal can be

obtained at a desired resolution without lowering the

recognition accuracy.

It is to be noted that the present invention may

be applied to a system having multiple constituent

15   devices (for example, a host computer, an interface

device, a reader, a printer and others) or to an

apparatus constituted by a single device (for example,

a copying machine, a facsimile machine and others).

Further, it goes without saying that the object of

20   the present invention can be also achieved by supplying

a recording medium having a program code of a software

for realizing functions of the foregoing embodiments to

a system or an apparatus and thereafter reading and

executing the program code stored in the recording

25   medium by a computer (or a CPU or an MPU) in the system

or the apparatus.

In such a case, the program code itself read from

the recording medium realizes the functions of the above-described embodiments, and the recording medium storing the program code therein constitutes the present invention.

5　　　　As a recording medium for supplying the program code, a floppy-disk, a hard disk, an optical disk, a magneto-optical disk, a CD-ROM, a CD-R, a magnetic tape, a non-volatile memory card, a ROM and others can be used for example.

10　　　　Additionally, it is needless to say that executing the program code read by the computer not only realizes the functions of the above-described embodiments, it also causes an OS (operating system) or the like which is operated on the computer to execute a part or all of

15　　the actual processing based on indications of the program code, thereby realizing the functions of the above-described embodiments by this processing.

　　　　Further, when the program code read from the recording medium is written in a memory provided in a

20　　function extending board inserted into the computer or a function extending unit connected to the computer and thereafter a CPU or the like provided in the function extending board or the function extending unit executes a part or all of the actual processing based on

25　　indications of the program code, the functions of the above-described embodiments are likewise realized by this processing of course.

Although the present invention has been described in connection with the preferred embodiments, the present invention should not be restricted to these embodiments and it is apparent that various

5   modifications and applications are possible within a true scope of the appended claims.